NAVAIR 17-20AF-77L

TECHNICAL MANUAL

INSTRUMENT CALIBRATION PROCEDURE

COUNTER

HEWLETT-PACKARD 5340A, OPT 001, 002

AF-77L

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SECTION 1

INTRODUCTION AND DESCRIPTION

1.1 This procedure describes the calibration and adjustment of the Hewlett Packard 5340A Opt. 001, 002 Counter. The instrument will be referred to herein as the TI (Test Instrument).

1.2 This procedure was prepared by Hughes Aircraft for use by Phase F-14 activities. All comments should be forwarded to the Metrology Engineering Center, Naval Plant Representative Office, Pomona, California. Use of the Calibration Problem Report cards provided with this procedure is recommended.

Table 1. Calibration Description

TI Characteristics	Performance Specifications	Test Method
Self Check (4.1)	Acc: ±1 count displayed Standard frequency amplitude: 2.4 V p-p or greater Counting unit range: 0 to 18 GHz	Self check of basic TI functions. Signal amplitude observed with oscilloscope
Sensitivity 10 Hz to 250 MHz Range (4.2)	Sensitivity: 50 mV Bandwidth: 10 Hz to 250 MHz	Signal applied to TI for stable count
Sensitivity 10 Hz to 18 GHz Range (4.3)	Sensitivity: -30 dBm (10 Hz to 500 MHz) -35 dBm (500 MHz to 10 GHz) -25 dBm (10 to 18 GHz	Signal applied to TI for stable count.
Oscillator (4.4)	Acc: $\leq 5 \times 10^{-9}$ after 1 hour Line voltage (10% change): $\leq 1 \times 10^{-10}$ change from reference Stability: $\leq 5 \times 10^{-10}$ per day after 24 hours	Compared to standard frequency

SECTION 2

EQUIPMENT REQUIREMENTS

NOTE

Minimum use specifications are the principal parameters required for performance of the calibration, and are included to assist in the selection of alternate equipment, which may be used at the discretion of the using laboratory. Satisfactory performance of alternate items shall be verified prior to use. All applicable equipment must bear evidence of current calibration.

Item	Minimum Use Specifications	Recommended Test Equipment[1]	Use[2]
2.1 Autotransformer	Input voltage: 105 to 125 V, 60 Hz, single phase Output voltage: adjustable from 105 to 125 V at 5 amps, metered output	General Radio Model W10NT3A Autotransformer	C, A
2.2 Oscilloscope	Frequency response: DC to 10 MHz Vertical sensitivity: .05 to 1 V/div Sweep timing: 10 msec to .1 usec/div Modes: Dual channel with algebraic adding	Tektronix Model 7704A Oscilloscope with Tektronix Model 7A26 Amplifier and Tektronix Model 7B53A Time Base	C, A

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[1] The instruments utilized in this procedure were selected from those known to be available at Department of Defense facilities, and the listing by make or model number carries no implication of preference, recommendation, or approval by the Department of Defense for use by other agencies. It is recognized that equivalent equipment produced by other manufacturers may be capable of equally satisfactory performance in the procedure.

[2] The instruments utilized in this procedure that are required for Calibration are identified with a "C". The instruments utilized for Adjustments are identified with an "A". Instruments required for both Calibration and Adjustment are identified as "C, A".

Item	Minimum Use Specifications	Recommended Test Equipment[1]	Use[2]
2.3 Cable (3 required)	36 inch, RG-58/U, BNC male to BNC male	Pomona Model 2249-C-36 Cable Assembly	C, A
2.4 Termination	Resistance: 50 ohms Connector: BNC	Hewlett Packard Model 11593A Termination (p/o TI)	C, A
2.5 Probe (2 required)	Divider: 10:1	Tektronix Model P6053B Passive Probe	C, A
2.6 Adapter (2 required)	BNC female to double banana plugs	Pomona Model 1269 Adapter	A
2.7 Adapter (3 required)	BNC female to red and black mini-test clips grabber	Pomona Model 3788 Adapter	A
2.8 Multimeter	DC voltage: 0 to ±15 V dc Acc: ±0.1%	Fluke Model 8350A Digital Multimeter	A
2.9 Generator	Frequency: 10 Hz to 1 MHz Output: 50 mV	Hewlett Packard Model 3310B Function Generator	C, A
2.10 Termination	50 ohms, BNC feedthru	Tektronix Model 011-0099-00 Termination	C, A
2.11 Generator	Frequency: 1 to 300 MHz Voltage: 0 to 1000 mV Power: 0 to -100 dBm	Hewlett Packard Model 8640B Signal Generator	C, A
2.12 Voltmeter	Frequency: 10 Hz to 1 MHz Range: 0 to 50 mV (-23 dB) Acc: ±(2.5% reading + 2.5% FS), 10 to 40 Hz ± 1% reading, 40 Hz to 1 MHz	Hewlett Packard Model 400E Voltmeter	C

(Continued on page 4)

Item	Minimum Use Specifications	Recommended Test Equipment [1]	Use [2]
2.13 Adapter	BNC tee, female, male, female	Pomona Model 3285A Adapter	C, A
2.14 Power Divider	Frequency: 500 MHz to 18 GHz Symmetry: 0.5 dB max between ports	Weinschel Model 1506A Power Divider	C, A
2.15 Adapter (2 required)	N male to BNC female	Pomona Model 3288 Adapter	C, A
2.16 Cable	36 inch, RG-213/U, N male to N male	Pomona Model 1658-S-36 Cable Assembly	C, A
2.17 Generator	Frequency: 500 MHz to 18 GHz Power: 0 to -35 dBm	Hewlett Packard Model 8620A Sweep Generator with Hewlett Packard Model 8621B RF Drawer and Hewlett Packard Models 86320B, 86330B, 86341B, 86342A RF Module and Hewlett Packard Models 86250C, 86260A RF Oscillator	C, A
2.18 Power Meter	Range: 0 to -35 dBm Acc: ±1% FS	Hewlett Packard Model 435A Power Meter	C, A
2.19 Power Sensor	Frequency: 500 MHz to 18 GHz Power: 0 to -35 dBm	Hewlett Packard Model 8481A Power Sensor	C, A

(Continued on page 5)

Item	Minimum Use Specifications	Recommended Test Equipment[1]	Use[2]
2.20 Extender Board	Compatible with TI	Hewlett Packard Model 05340-60047 Extender Board	A
2.21 Power Supply	Voltage: 0 to 15 V dc Current: 0 to 100 ma	Hewlett Packard Model 6296A Power Supply	A
2.22 Resistor	Resistance: 1000 ohms Acc: ±5%	Bench Stock	A
2.23 Adapter	SMB male to BNC female	Hewlett Packard Model 1250-1236 Adapter	A
2.24 Frequency Standard	Output: 1 MHz Acc: $\pm 0.3 \times 10^{-11}$ (1 sec average)	Hewlett Packard Model 5061A Cesium Beam Frequency Standard	C, A
2.25 Frequency Comparator	Input frequency: 1 MHz Range: 10^{9} to 10^{11}	Tracor Model 527A Frequency Difference Meter	C, A

SECTION 3

PRELIMINARY OPERATIONS

3.1 Verify that all power switches are off and connect all applicable equipment, except the TI, to the appropriate power source.

3.2 Before power switches are turned on, set all auxiliary equipment controls so that dangerous voltages will not be present on output terminals and to avoid damage to the equipment.

3.3 Energize equipment listed in Section 2 and allow sufficient time for equipment to warm-up and stabilize.

3.4 Adjust autotransformer (2.1) output voltage control for minimum.

3.5 Set TI SELECTOR switch (rear) to 115 V, if necessary.

3.6 Connect TI power cord to autotransformer and adjust autotransformer voltage control for meter indication of 115 volts.

3.7 Set TI LINE switch to on (up). TI indicators light.

3.8 Connect termination (2.4) to TI 10 Hz - 250 MHz INPUT connector (front panel).

3.9 Position TI controls as follows:

RESOLUTION Hz switch 1
SAMPLE RATE control ..... fully ccw
RANGE switch ..... CHK
INT - EXT switch (rear) ..... INT

3.10 Allow 1 hour warm-up and, if necessary, readjust autotransformer for 115 volts.

SECTION 4

CALIBRATION PROCESS

NOTE

Unless otherwise specified, verify the results of each test and take corrective action whenever the test requirement is not met, before proceeding.

4.1 SELF CHECK

4.1.1 Connect oscilloscope (2.2) vertical input connector to TI 10 MHz OUTPUT connector (rear) with probe (2.5).

4.1.2 Note oscilloscope CRT 10 MHz signal display amplitude.

4.1.3 TI indicates between 9.999999 and 10.000001 MHz.

4.1.4 Adjust autotransformer voltage control for meter indication of 105 volts.

4.1.5 Oscilloscope CRT displays 10 MHz signal amplitude within 0.1 V p-p of amplitude noted in step 4.1.2 and TI indicates between 9.999999 and 10.000001 MHz. If not, refer to Section 5.1 for adjustments.

4.1.6 Adjust autotransformer voltage control for meter indication of 125 volts.

4.1.7 Oscilloscope CRT displays 10 MHz signal amplitude within 0.1 V p-p of amplitude noted in step 4.1.2 and I indicates between 9.999999 and 10.000001 MHz. If not, refer to Section 5.1 for adjustments.

4.1.8 Adjust autotransformer voltage control for meter indication of 115 volts.

4.1.9 Oscilloscope CRT displays 10 MHz signal amplitude 2.4 V p-p or greater.

4.1.10 Set TI RESOLUTION switch to settings listed in Table 2. At each setting TI indicates within specified limits.

Table 2. Self Check Indication

TI	
RESOLUTION Hz Switch Setting	Indication
10	9.99999 to 10.00001 MHz
100	9.9999 to 10.0001 MHz
1k	9.999 to 10.001 MHz
10k	9.99 to 10.01 MHz
100k	9.9 to 10.1 MHz
1M	.009 to .011 GHz

4.1.11 Set TI RESOLUTION Hz switch to 1.

4.1.12 Disconnect equipment.

4.1.13 Set TI RANGE switch to 10 Hz - 250 MHz.

4.2 SENSITIVITY 10 Hz to 250 MHz RANGE

4.2.1 Ensure that termination (2.4) is connected to TI 10 Hz - 250 MHz INPUT connector (front panel).

4.2.2 Connect equipment as shown in Figure 1.

4.2.3 Adjust generator (2.9) controls for frequencies listed in Table 3 and voltmeter (2.12) indication of 50 mV. At each frequency TI indicates stable count and DIR indicator lights. If not, refer to Section 5.2 for adjustments.

Table 3. 10 Hz to 1 MHz Sensitivity

Generator (2.9) Frequency
10 Hz
100 Hz
1 kHz
10 kHz
100 kHz
1 MHz

4.2.4 Disconnect equipment and connect as shown in Figure 2.

4.2.5 Set TI RESOLUTION Hz switch to 100.

4.2.6 Adjust generator (2.11) controls for 50 mV and frequencies listed in Table 4. At each frequency TI indicates stable count and DIR indicator lights. If not, refer to Section 5.2 for adjustments.

Table 4. 1 to 250 MHz Sensitivity

Generator (2.11) Frequency
1 MHz
10 MHz
100 MHz
200 MHz
250 MHz

4.2.7 Disconnect equipment.

4.3 SENSITIVITY 10 Hz to 18 GHz RANGE

4.3.1 Connect equipment as shown in Figure 3.

4.3.2 Set TI RANGE switch to 10 Hz - 18 GHz and RESOLUTION Hz switch to 1.

CAUTION

Damage to 10 Hz - 18 GHz INPUT will occur if input exceeds 1 watt (+30 dBm).

4.3.3 Adjust generator (2.9) controls for frequencies listed in Table 3 and voltmeter indication of -30 dB. At each frequency TI indicates stable count and DIR indicator lights. If not, refer to Section 5.3 for adjustments.

4.3.4 Disconnect equipment and connect as shown in Figure 4.

4.3.5 Set TI RESOLUTION Hz switch to 100.

4.3.6 Adjust generator (2.11) controls for -30 dBm and frequencies listed in Table 4. At each frequency TI indicates stable count and DIR indicator lights. If not, refer to Section 5.3 for adjustments.

4.3.7 Disconnect equipment and connect as shown in Figure 5. Ensure cable connections are as shown or cable (2.16) loss will affect indication.

4.3.8 Adjust generator (2.17) controls for frequency and power meter (2.18) indication listed in Table 5. At each frequency TI indicates stable count and LOCK indicator lights. If not, refer to Section 5.4 for adjustments.

Table 5. 500 MHz to 18 GHz Sensitivity

Generator (2.17) Frequency	Power Meter Indication (dBm)
500 MHz	-35
1 GHz	-35
3 GHz	-35
5 GHz	-35
7 GHz	-35
9 GHz	-35
10 GHz	-25
12 GHz	-25
14 GHz	-25
16 GHz	-25
18 GHz	-25

4.3.9 Set TI RANGE switch to 250 MHz - 18 GHz.

4.3.10 Repeat step 4.3.8.

4.3.11 Disconnect equipment.

4.4 OSCILLATOR

NOTE

TI must operate continuously for 1 hour before performing the following steps.

4.4.1 Connect equipment as shown in Figure 6.

NOTE

In the following steps, allow adequate time to ensure that TI drift rate is within limits listed.

4.4.2 Set frequency comparator (2.25) range switch to 10^9.

4.4.3 Frequency comparator indicates 5.0 parts in 10^9 or less. If not, refer to Section 5.5 for adjustments.

4.4.4 Record frequency comparator indication.

4.4.5 Adjust autotransformer voltage control for meter indication of 105 volts. Wait two minutes.

4.4.6 Frequency comparator indicates 0.1 parts in 10^9 or less change from indication recorded in step 4.4.4. If not, refer to Section 5.5 for adjustments.

4.4.7 Adjust autotransformer voltage control for meter indication of 125 volts. Wait two minutes.

4.4.8 Frequency comparator indicates 0.1 parts in 10^9 or less change from indication recorded in step 4.4.4. If not, refer to Section 5.5 for adjustments.

4.4.9 Adjust autotransformer voltage control for meter indication of 115 volts.

4.4.10 Set frequency comparator range switch to 10^{11}.

NOTE

TI must be continuously connected to a 115 V AC source for at least 24 hours before performing the following steps.

4.4.11 Record frequency comparator indication.

4.4.12 Wait one hour.

4.4.13 Record frequency comparator indication.

4.4.14 Difference between frequency comparator indications recorded in steps 4.4.11 and 4.4.13 is 2.1 parts in 10^{11} per hour or less ($\leq 5 \times 10^{-10}$ per 24 hr.). If not, refer to Section 5.5 for adjustments.

4.4.15 Disconnect equipment.

4.5 TI SHUTDOWN

4.5.1 De-energize and disconnect equipment.

4.5.2 Re-install protective covers on TI.

4.5.3 Complete calibration decal and affix to TI.

SECTION 5

ADJUSTMENT PROCESS

NOTE

The adjustment steps in this section of the procedure are included only to correct for an out-of-tolerance condition noted during the calibration process. Remove and replace TI protective covers as required.

5.1 POWER SUPPLY

5.1.1 Adjust autotransformer voltage control for meter indication of 115 volts.

5.1.2 Connect multimeter (2.8) input connector to TI A28TP2 test point (Figure 7) and ground with cable (2.3), adapter (2.6), and adapter (2.7).

5.1.3 Adjust TI A28R7 adjustment (Figure 7) for multimeter indication between -14.95 and -15.05 V dc.

5.1.4 Disconnect adapter (2.7) from TI A28TP2 and connect to TI A29TP2 test point (Figure 7).

5.1.5 Adjust TI A29R5 adjustment (figure 7) for multimeter indication between 14.95 and 15.05 V dc.

5.1.6 Disconnect adapter (2.7) from TI A29TP2 and connect to TI A31TP2 test point (Figure 7).

5.1.7 Adjust TI A31R9 adjustment (Figure 7) for multimeter indication between -4.95 and -5.05 V dc.

5.1.8 Disconnect adapter (2.7) from TI A31TP2 and connect to TI A31TP3 test point (Figure 7).

5.1.9 Adjust TI A31R2 adjustment (Figure 7) for multimeter indication between -4.95 and -5.05 V dc.

5.1.10 Disconnect adapter (2.7) from TI A31TP3 and connect to TI A32TP1 test point (Figure 7).

5.1.11 Adjust TI A32R6 adjustment (Figure 7) for multimeter indication between 4.95 and 5.05 V dc.

5.1.12 Disconnect adapter (2.7) from TI A32TP1 and connect to TI A32TP2 test point (Figure 7).

5.1.13 Adjust TI A32R3 adjustment (Figure 7) for multimeter indication between 4.95 and 5.05 V dc.

5.1.14 Disconnect adapter (2.7) from TI A32TP2 and connect to TI A33TP1 test point (Figure 7).

5.1.15 Adjust TI A33R8 adjustment (Figure 7) for multimeter indication between 10.95 and 11.05 V dc.

5.1.16 Disconnect multimeter, cable (2.3), adapter (2.6), and adapter (2.7).

5.1.17 Continue procedure starting with step 4.1.2.

5.2 10 Hz to 250 MHz SENSITIVITY

5.2.1 Connect equipment as shown in Figure 2.

5.2.2 Set TI RESOLUTION Hz switch to 100.

5.2.3 Adjust generator (2.11) controls for 100 MHz and 100 mV output.

5.2.4 Adjust TI A33R10 adjustment (Figure 7) for TI indication of stable count.

5.2.5 Decrease generator (2.11) output amplitude for TI indication of unstable count.

5.2.6 Readjust TI A33R10 adjustment (Figure 7) for TI indication of stable count.

5.2.7 Repeat steps 5.2.5 and 5.2.6 for TI indication of stable count with generator (2.11) minimum output.

5.2.8 Set TI RESOLUTION Hz switch to 1.

5.2.9 Continue procedure starting with step 4.2.2.

5.3 DIRECT SENSITIVITY

5.3.1 Connect equipment as shown in Figure 4.

5.3.2 Adjust generator (2.11) controls for 100 MHz and -25 dBm output.

5.3.3 Remove 4 screws and TI A17 assembly cover (Figure 7).

5.3.4 Ensure that TI A17 assembly board knurled hold down screw is firmly finger tight.

5.3.5 Replace TI A17 assembly cover and 4 screws.

5.3.6 Turn TI THRESHOLD DETECTOR ADJUST adjustment (Figure 8) fully ccw.

5.3.7 Adjust TI SENSITIVITY ADJUST adjustment (Figure 8) for TI indication of stable count.

NOTE

In steps 5.3.8 thru 5.3.10 position RESOLUTION Hz switch for best resolution.

5.3.8 Decrease generator (2.11) output amplitude for TI indication of unstable count.

5.3.9 Readjust TI SENSITIVITY ADJUST adjustment (Figure 8) for TI indication of stable count.

5.3.10 Repeat steps 5.3.8 and 5.3.9 for TI indication of stable count with generator (2.11) minimum output.

5.3.11 Note generator (2.11) output amplitude setting in dB.

5.3.12 Turn TI THRESHOLD DETECTOR ADJUST adjustment (Figure 8) fully cw. TI indicates all zeros.

5.3.13 Adjust generator (2.11) output amplitude control for output 1 dB greater than output noted in step 5.3.11.

5.3.14 Turn TI THRESHOLD DETECTOR ADJUST adjustment (Figure 8) until TI just indicates stable count.

5.3.15 Disconnect cable (2.3) from TI OPTION 001 INPUT connector.

5.3.16 TI indicates all zeros. If not, connect cable (2.3) to TI OPTION 001 INPUT connector, turn TI THRESHOLD DETECTOR ADJUST adjustment fully cw and repeat steps 5.3.14 thru 5.3.16 until both conditions are met.

5.3.17 Continue procedure starting with step 4.3.1.

NOTE

Perform steps 5.3.18 thru 5.3.36 only if previous adjustments do not correct problem.

5.3.18 Set TI LINE switch to OFF.

5.3.19 Extend TI A22 board (Figure 8) with extender board (2.20).

5.3.20 Disconnect cable connected to TI A22J1 connector (Figure 9).

NOTE

Remove 4 screws and cover for access to TI A17 board (Figure 8).

5.3.21 Remove TI A17 board (Figure 8).

5.3.22 Connect equipment as shown in Figure 10. See Figure 9 for location of TI A22J1 and A22R30.

5.3.23 Set TI LINE switch to on (up).

5.3.24 Adjust power supply (2.21) controls for 10 V dc output.

5.3.25 Adjust generator (2.11) controls for 300 MHz and -100 dBm output.

5.3.26 Turn TI A22R52 adjustment (Figure 9) to center of range.

5.3.27 Adjust power supply controls for multimeter indication between -0.002 and 0.002 V dc.

5.3.28 Maintain multimeter indication and adjust generator (2.11) controls for 12 MHz and -10 dBm output.

5.3.29 Adjust TI A22R52 adjustment (Figure 9) for TI indication of stable count.

5.3.30 Set TI LINE switch to OFF.

5.3.31 Adjust power supply controls for 0 V output.

5.3.32 Disconnect equipment.

5.3.33 Connect TI cable to TI A22J1 (Figure 9).

5.3.34 Install TI A17 and A22 boards into TI (Figure 8).

5.3.35 Set TI LINE switch to on (up).

5.3.36 Repeat steps 5.3.1 thru 5.3.17.

5.4 TRANSFER OSCILLATOR SENSITIVITY

5.4.1 On TI remove 12 screws and cover from large casting (right rear, inside).

NOTE

Do not extend TI A15 board in following adjustment.

5.4.2 Connect oscilloscope Ch A input connector to TI A15 board pin 1 (Figure 11) and ground with probe (2.5). See Figure 8 for location of TI A15.

5.4.3 Connect oscilloscope Ch B input connector to TI A15 board pin 2 (Figure 11) and ground with probe (2.5).

5.4.4 Position oscilloscope controls as follows:

Sweep time	.1 usec/div
Ch A sensitivity	.05 V/div
Ch B sensitivity	.05 V/div
Ch A polarity	+ up
Ch B polarity	- up
Display mode	A + B

5.4.5 Adjust TI A15C3 adjustment (Figure 8) for oscilloscope CRT display of maximum amplitude.

5.4.6 Adjust TI A15C11 and A15C13 adjustments (Figure 8) for oscilloscope CRT display maximum amplitude. Adjustments interact. Repeat until no further improvement is obtained.

5.4.7 Disconnect equipment.

5.4.8 Set TI LINE switch to OFF.

5.4.9 Remove TI A7 board (Figure 8).

5.4.10 Connect equipment as shown in Figure 12. See Figure 8 for location of TI A7 and A11 boards.

5.4.11 Adjust power supply controls for 0 V output.

5.4.12 Set TI LINE switch to on (up).

5.4.13 Adjust power supply controls for multimeter indication of 9.00 V dc.

5.4.14 Turn TI A8R13 and A9R4 adjustments (Figure 8) fully cw.

5.4.15 Position oscilloscope controls as follows:

Ch A sensitivity	.01 V/div
Ch A coupling	AC
Ch A polarity	+ up
Trigger mode	Internal
Trigger coupling	AC
Trigger slope	-
Sweep time	50 usec/div

NOTE

Adjust TI A9R1 adjustment (Figure 8) for oscilloscope CRT display of sine wave, if necessary.

5.4.16 Adjust oscilloscope controls for CRT display of centered sine wave.

5.4.17 Connect TI 10 Hz - 250 MHz INPUT connector to TI A16J6 (Figure 13) with cable (2.3) and adapter (2.7).

5.4.18 Set TI RANGE switch to 10 Hz - 250 MHz.

NOTE

Observe oscilloscope CRT display for sine wave maximum distortion.

5.4.19 Adjust power supply controls for TI indication ranging from 100 to 185 MHz.

5.4.20 Note point of oscilloscope CRT display of maximum distortion as TI indication ranges from 100 to 185 MHz.

NOTE

TI indication must be between 100 and 185 MHz.

5.4.21 Adjust power supply controls to point where oscilloscope CRT displays sine wave with maximum distortion.

NOTE

Set oscilloscope sweep time switch to 5 usec, 2 usec, and then 1 usec/div for best resolution as following adjustment is made.

5.4.22 Adjust TI A9R4 adjustment (Figure 8) for oscilloscope CRT display of minimum sine wave side jitter (phase noise).

5.4.23 Disconnect adapter (2.7) (connected to multimeter) from TI A7 pins 5 and 10, and connect to TI A9 pin 15 and ground. See Figure 8 for location of TI A9 board.

NOTE

Observe multimeter indication during next step.

5.4.24 Adjust power supply controls for TI indication ranging from 100 to 185 MHz.

5.4.25 Note point of multimeter maximum and minimum indications as TI indication ranges from 100 to 185 MHz.

5.4.26 Record multimeter maximum indication as V_{max}.

5.4.27 Record multimeter minimum indication as V_{min}.

5.4.28 Calculate algebraic average value of V_{max} (step 5.4.26) and V_{min} (step 5.4.27).

5.4.29 Disconnect probe (2.5) from TI A11 pin 1 and connect to TI A10 pin 7. See Figure 8 for location of TI A10 board.

5.4.30 Position oscilloscope controls as follows:

Ch A sensitivity ..... .2 V/div
Ch A coupling ..... GND
Sweep time ..... 5 msec/div

5.4.31 Turn oscilloscope Ch A vertical position control to position CRT trace at center graticule line.

5.4.32 Set oscilloscope Ch A coupling switch to DC.

5.4.33 Set power supply power switch to off.

5.4.34 Adjust TI A9R1 adjustment (Figure 8) for oscilloscope CRT ramp display centered about voltage calculated in step 5.4.28.

5.4.35 Disconnect probe (2.5) from TI A10 pin 7 and connect to TI A11 pin 1. See Figure 8 for location of TI A11 board.

5.4.36 Position oscilloscope controls as follows:

Ch A sensitivity ..... .02 V/div
Ch A coupling ..... AC
Sweep time ..... 50 usec/div

5.4.37 Set power supply power switch to on.

NOTE

Oscilloscope CRT displays waveform frequency of 20 kHz.

5.4.38 Adjust power supply controls for TI indication of 150 MHz.

NOTE

Continuously set power supply power switch to on and off while performing step 5.4.39.

5.4.39 Turn TI A8R13 adjustment (Figure 8) until oscilloscope CRT display waveform frequency just jumps from 20 kHz to 40 kHz.

5.4.40 Set power supply power switch to on.

5.4.41 Disconnect adapter (2.7) (connected to multimeter) from TI A9 pin 15 and connect to wiper of TI A8R13 adjustment (Figure 8) and ground.

5.4.42 Note multimeter indication.

5.4.43 Multiply multimeter indication noted in step 5.4.42 by 1.1 (+10%).

5.4.44 Adjust TI A8R13 adjustment (Figure 8) for multimeter indication calculated in step 5.4.43.

NOTE

Continuously set power supply power switch to on and off while performing step 5.4.45.

5.4.45 Adjust power supply controls for TI indication ranging from 100 to 185 MHz.

5.4.46 Oscilloscope CRT displays 20 kHz at all times. If not, multiply multimeter indication noted in step 5.4.42 by 1.2 (+20%).

5.4.47 Adjust TI A8R13 adjustment (Figure 8) for multimeter indication calculated in step 5.4.46.

5.4.48 Set power supply power switch to on.

5.4.49 Disconnect adapter (2.7) (connected to multimeter) from TI wiper of A8R13 and connect to TI A7 pin 10 and ground. See Figure 8 for location of TI A7 board.

5.4.50 Adjust power supply controls for TI indication of 100 MHz.

5.4.51 Record multimeter indication as V_1.

5.4.52 Adjust power supply controls for TI indication of 150 MHz.

5.4.53 Record multimeter indication as V_2.

5.4.54 Adjust power supply controls for TI indication of 185 MHz.

5.4.55 Record multimeter indication as V_3.

5.4.56 Adjust power supply controls for 0 V output.

5.4.57 Set TI LINE switch to OFF.

5.4.58 Disconnect equipment.

5.4.59 Install TI A7 board (Figure 8) into TI.

5.4.60 Set TI LINE switch to on (up).

5.4.61 Position oscilloscope controls as follows:

Ch A sensitivity 2V/div
Ch A coupling ..... GND
Ch A polarity ..... + up
Sweep time ..... 10 msec/div

5.4.62 Connect oscilloscope Ch A input connector to TI A7 pin 10 and ground with probe (2.5). See Figure 8 for location of TI A7 board.

5.4.63 Turn oscilloscope Ch A vertical position control to position CRT trace at bottom graticule line.

5.4.64 Set oscilloscope Ch A coupling to DC.

5.4.65 Set TI RANGE switch to 10 Hz - 18 GHz.

5.4.66 Turn TI A7R27 adjustment (Figure 8) fully cw.

5.4.67 Adjust TI A7R13 adjustment (Figure 8) for oscilloscope CRT display of waveform start and end level at V_2 (step 5.4.53) (Figure 14).

5.4.68 Adjust TI A5R15 and A7R25 adjustments (Figure 8) for oscilloscope CRT display of waveform top and bottom levels at V_1 (step 5.4.51) and V_3 (step 5.4.55) (Figure 14).

5.4.69 Disconnect equipment and connect as shown in Figure 4.

5.4.70 Adjust generator (2.11) controls for 280 MHz and -20 dBm output.

5.4.71 Connect multimeter to TI A4 pin 8 and ground with cable (2.3), adapter (2.6) and adapter (2.7). See Figure 8 for location of TI A4 board.

5.4.72 Adjust TI A13R31 adjustment (Figure 8) for multimeter indication between -440 and -460 mV dc.

5.4.73 Continue procedure starting with step 4.3.7.

5.5 OSCILLATOR FREQUENCY

NOTE

TI must be continuously connected to a 115 V ac source for at least 24 hours before performing the following steps.

5.5.1 Set frequency comparator range switch to 10^{10}.

5.5.2 Adjust TI FREQ ADJ adjustment (Figure 8) for frequency comparator indication of less than 5 parts in 10^{10}.

5.5.3 Continue procedure starting with step 4.4.4.

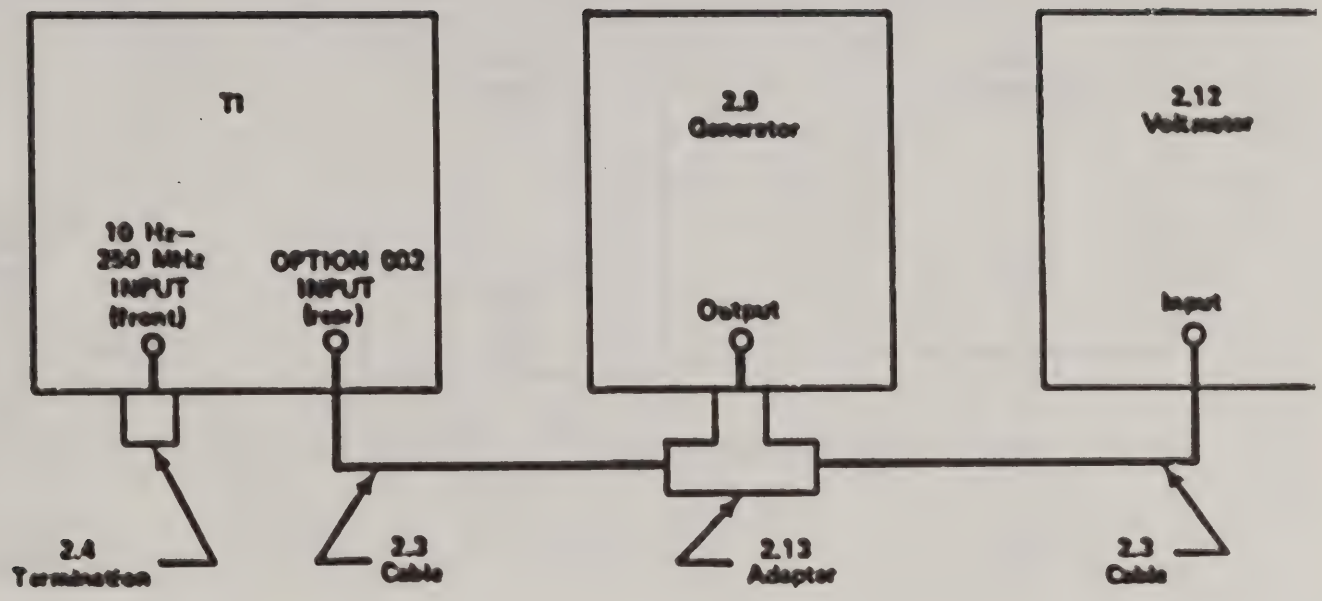

Figure 1. 10 Hz to 1 MHz Sensitivity Setup (10 Hz - 250 MHz Input)

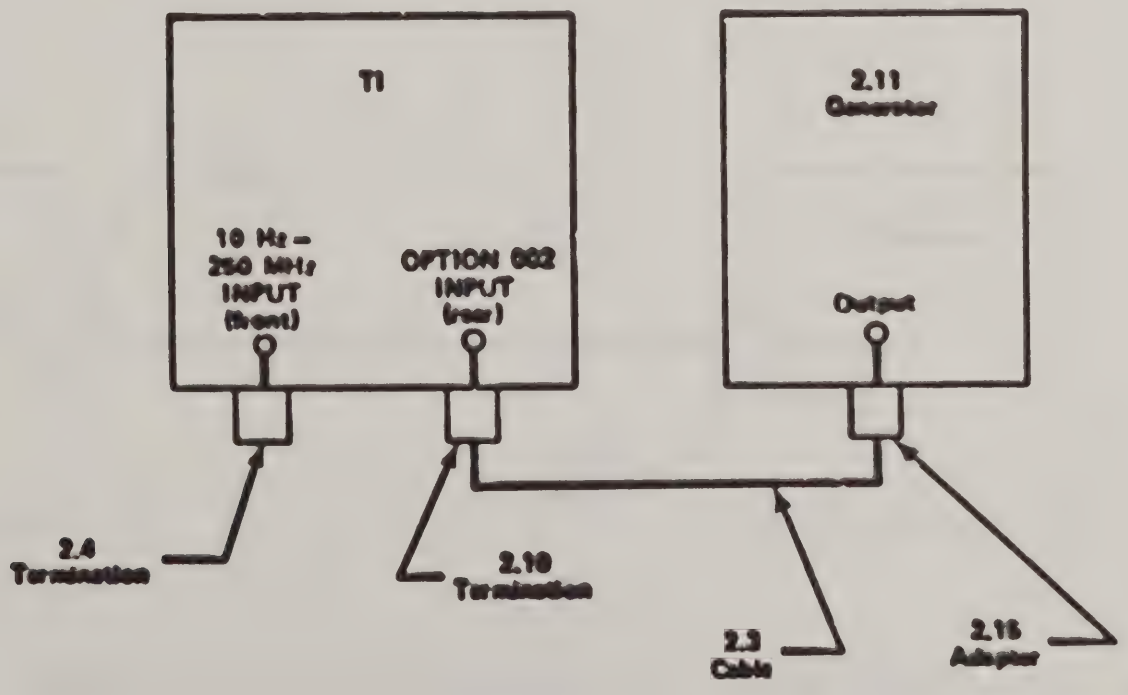

Figure 2. 1 to 250 MHz Sensitivity Setup (10 Hz - 250 MHz Input)

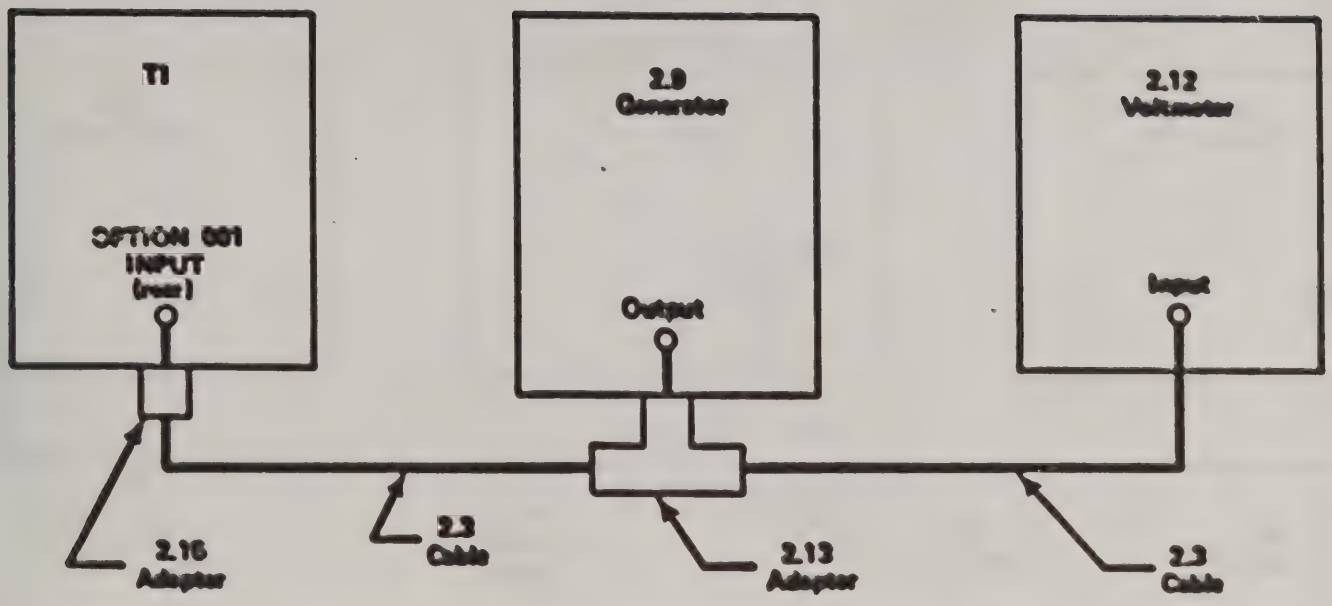

Figure 3. 10 Hz to 1 MHz Sensitivity Setup (10 Hz - 18 GHz Input)

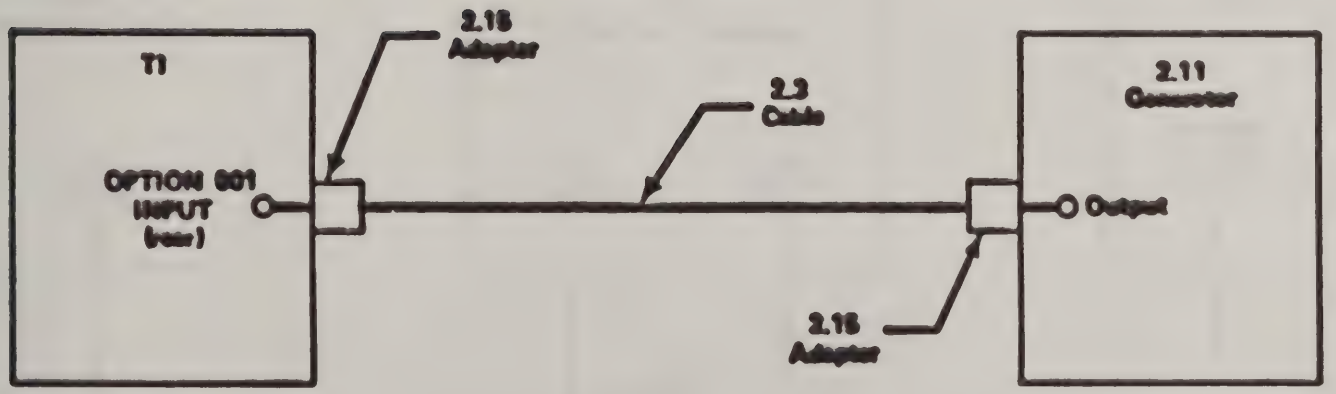

Figure 4. 1 to 250 MHz Sensitivity Setup (10 Hz - 18 GHz Input)

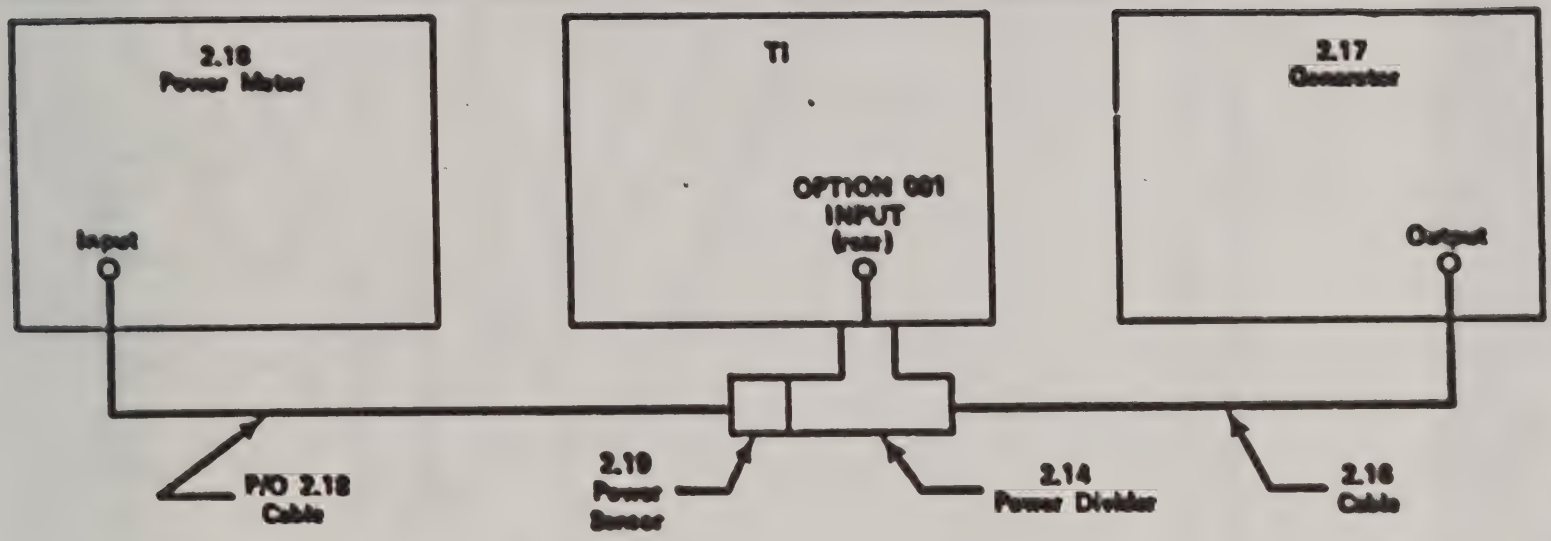

Figure 5. 500 MHz to 18 GHz Sensitivity Setup

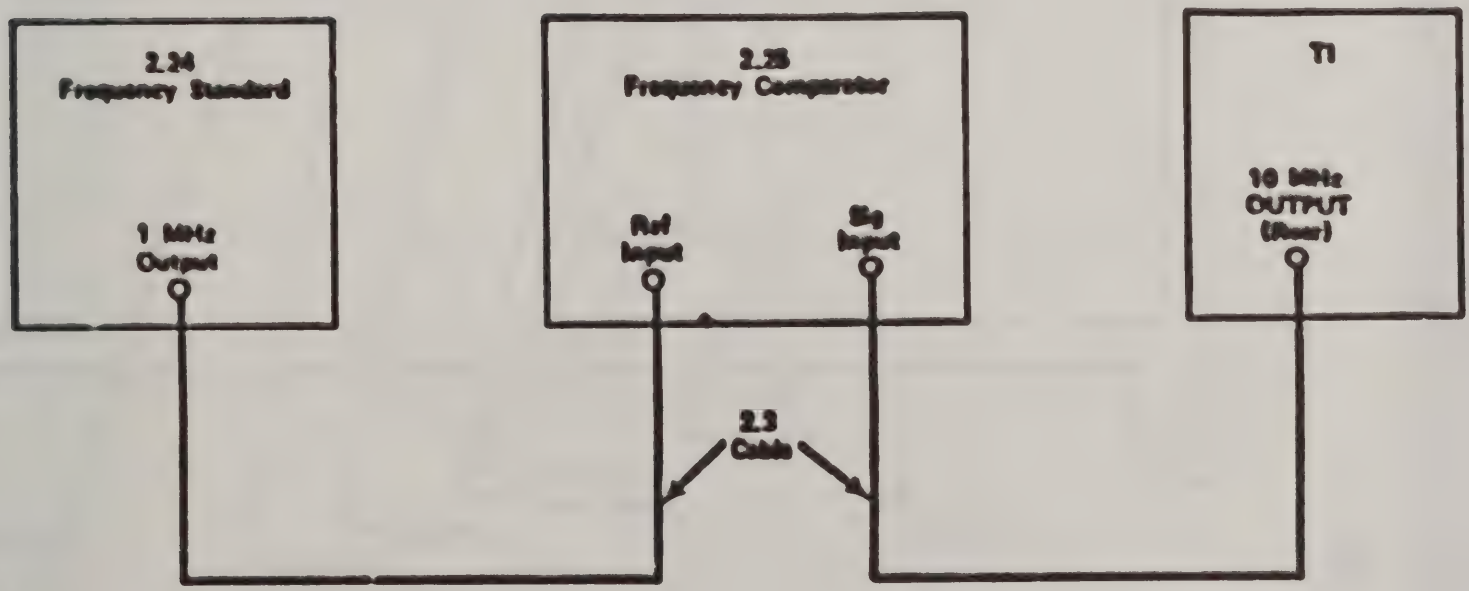

Figure 6. Oscillator Accuracy Setup

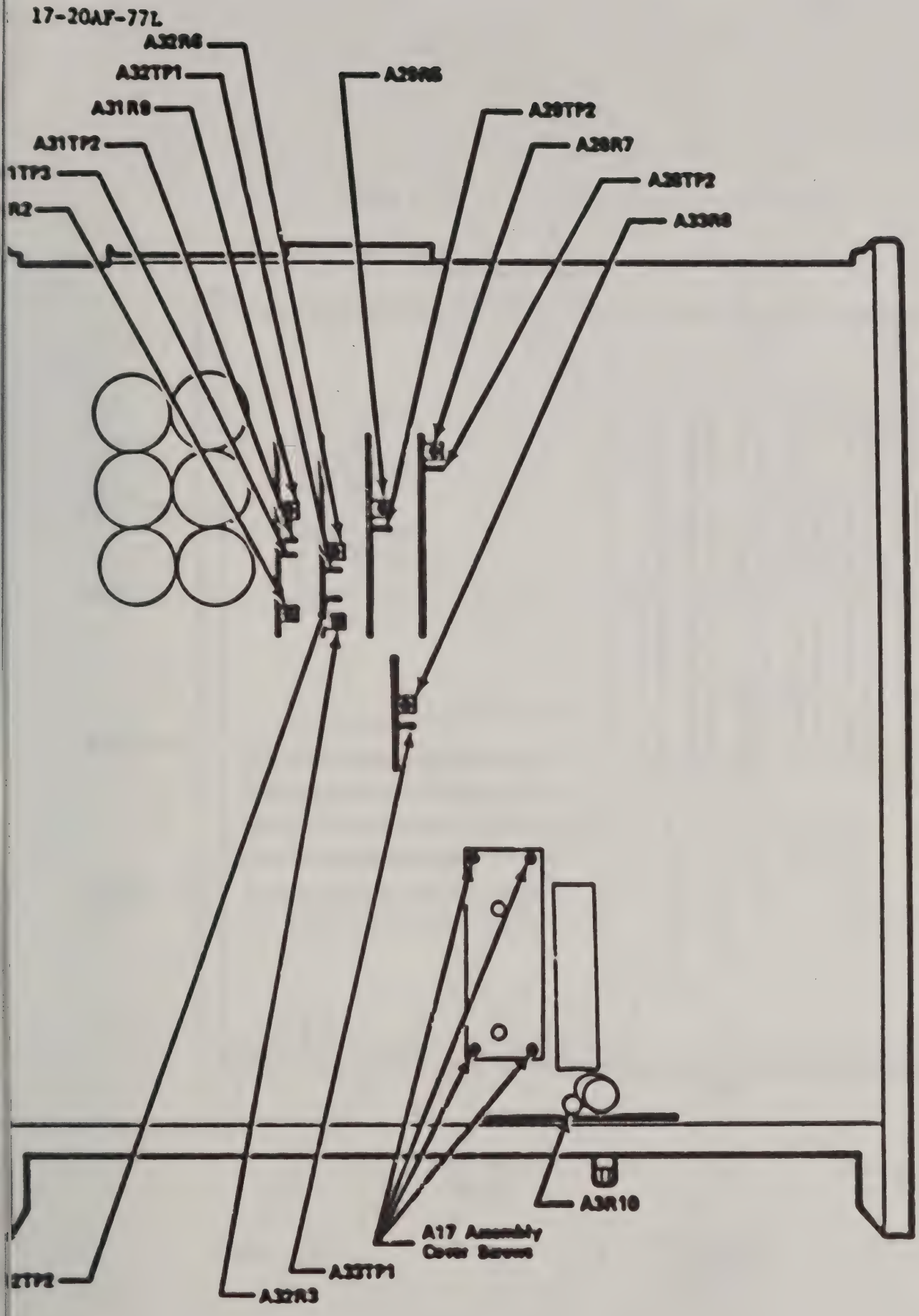

Figure 7. Power Supply Test Points/Adjustment Locations

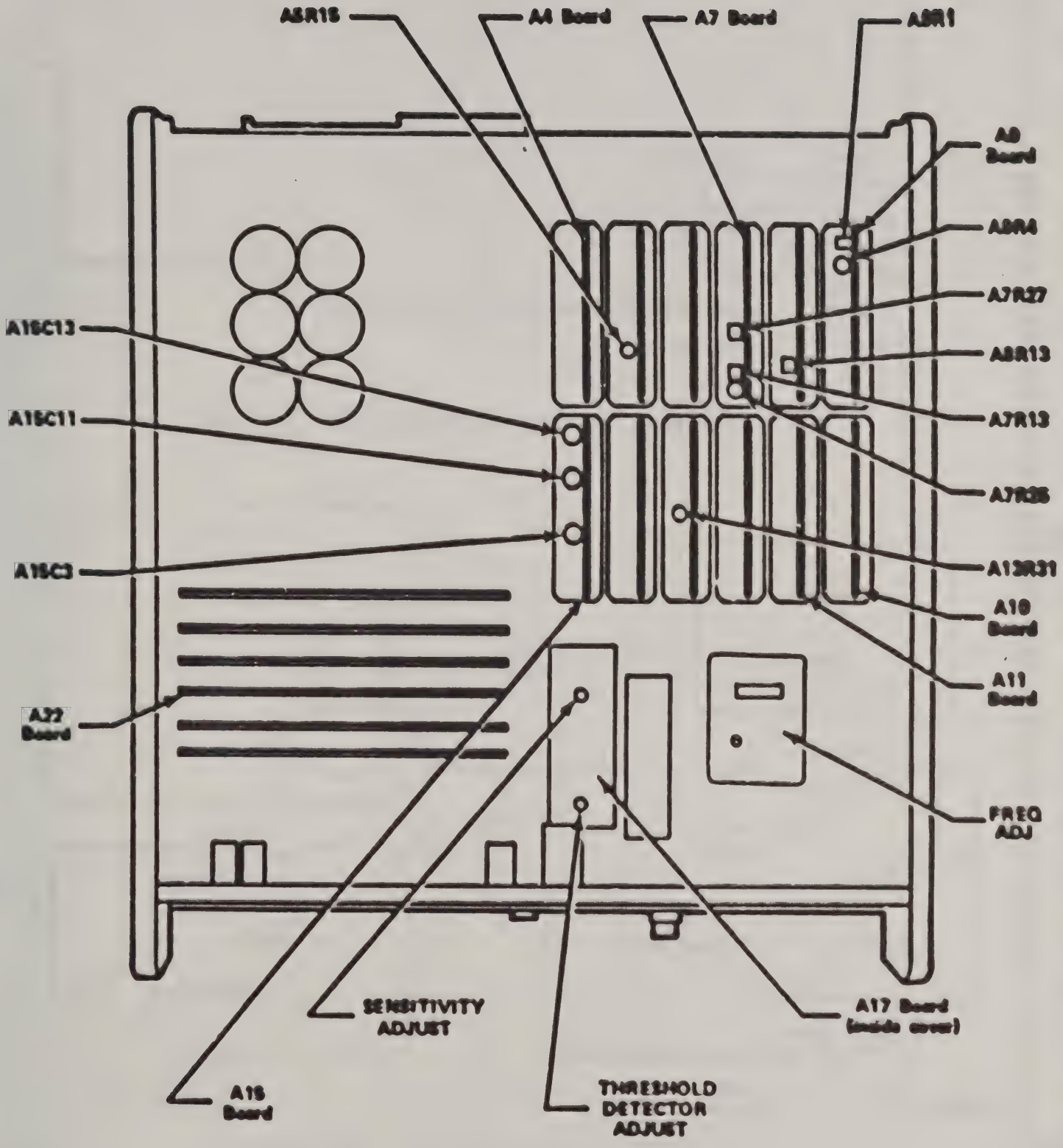

Figure 8. Sensitivity Adjustment Locations

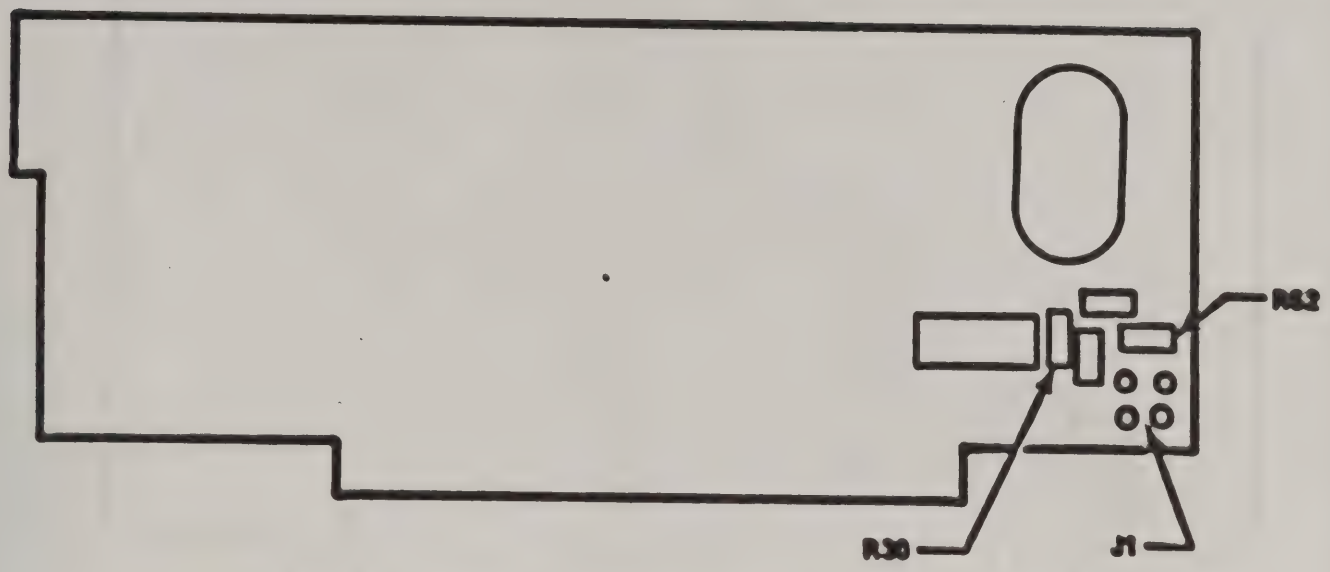

Figure 9. A22 Board Component Locations

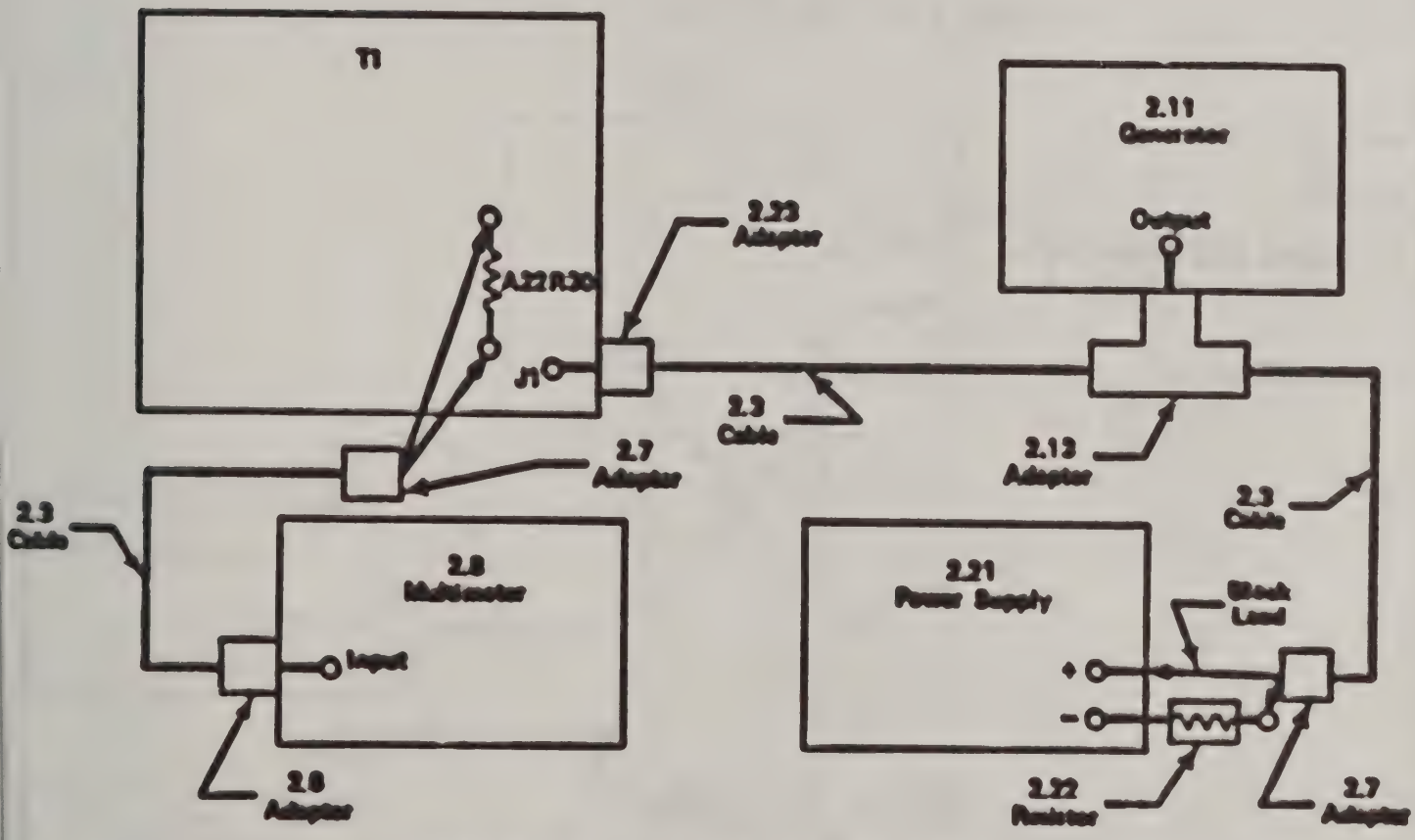

Figure 10. A22 Adjustment Setup

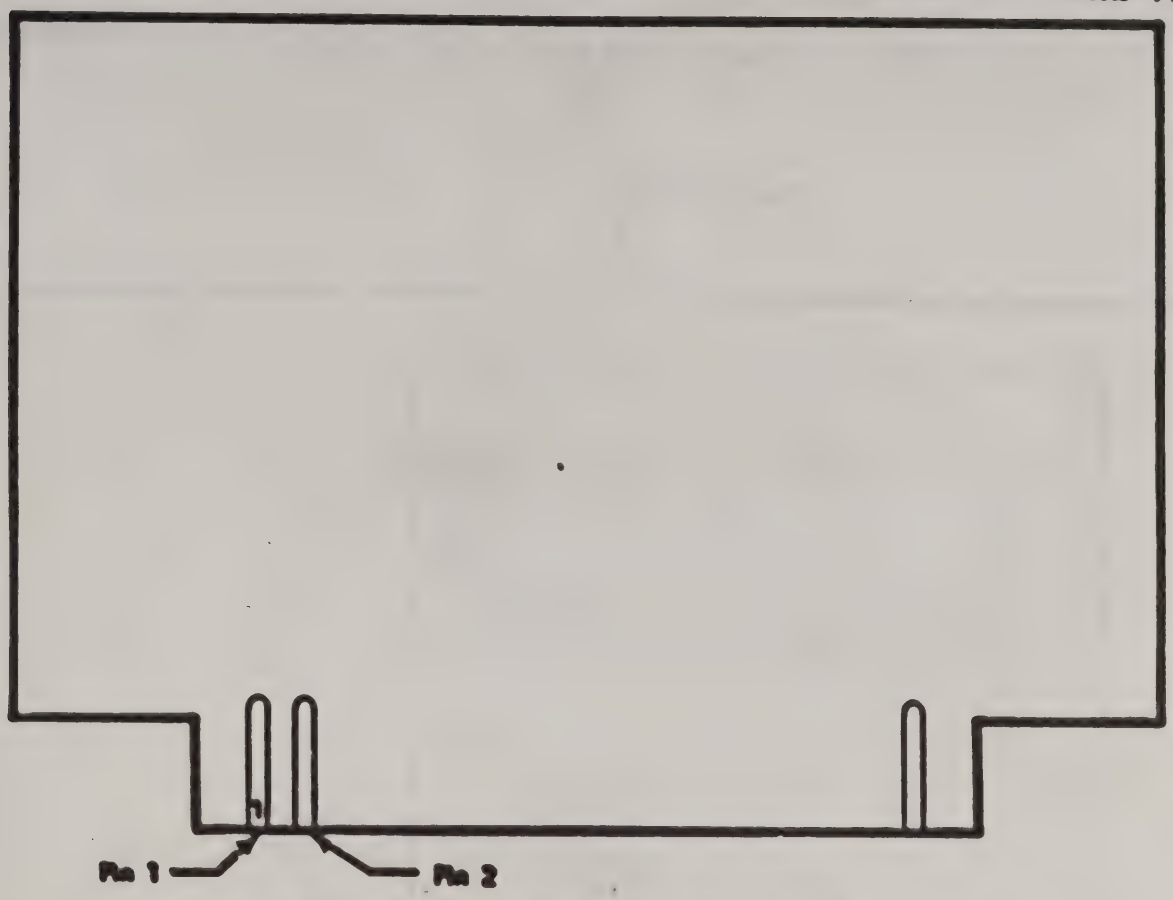

Figure 11. A15 Board Pin Locations

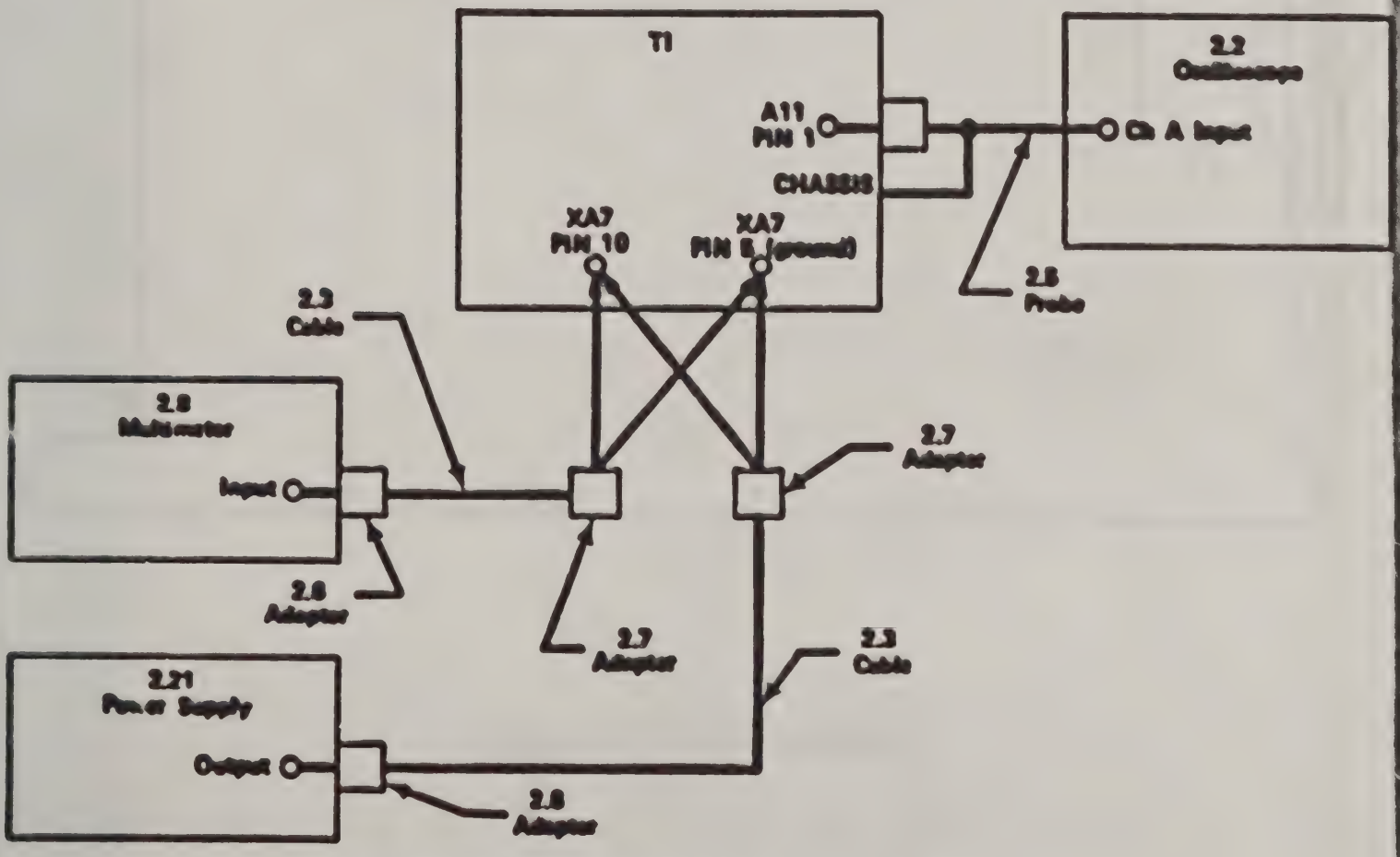

Figure 12. A8/A9 Adjustment Setup

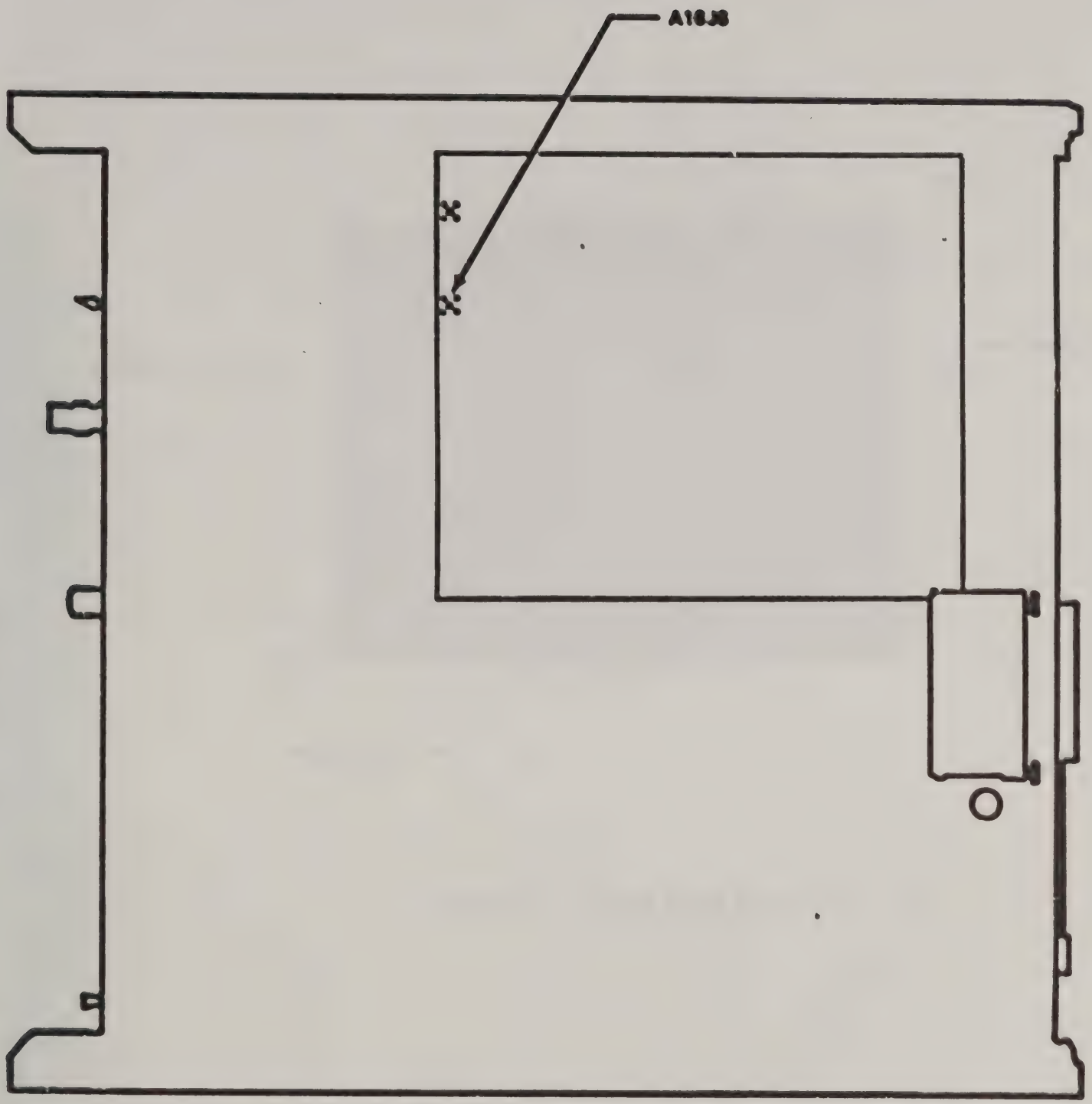

Figure 13. A16J6 Location

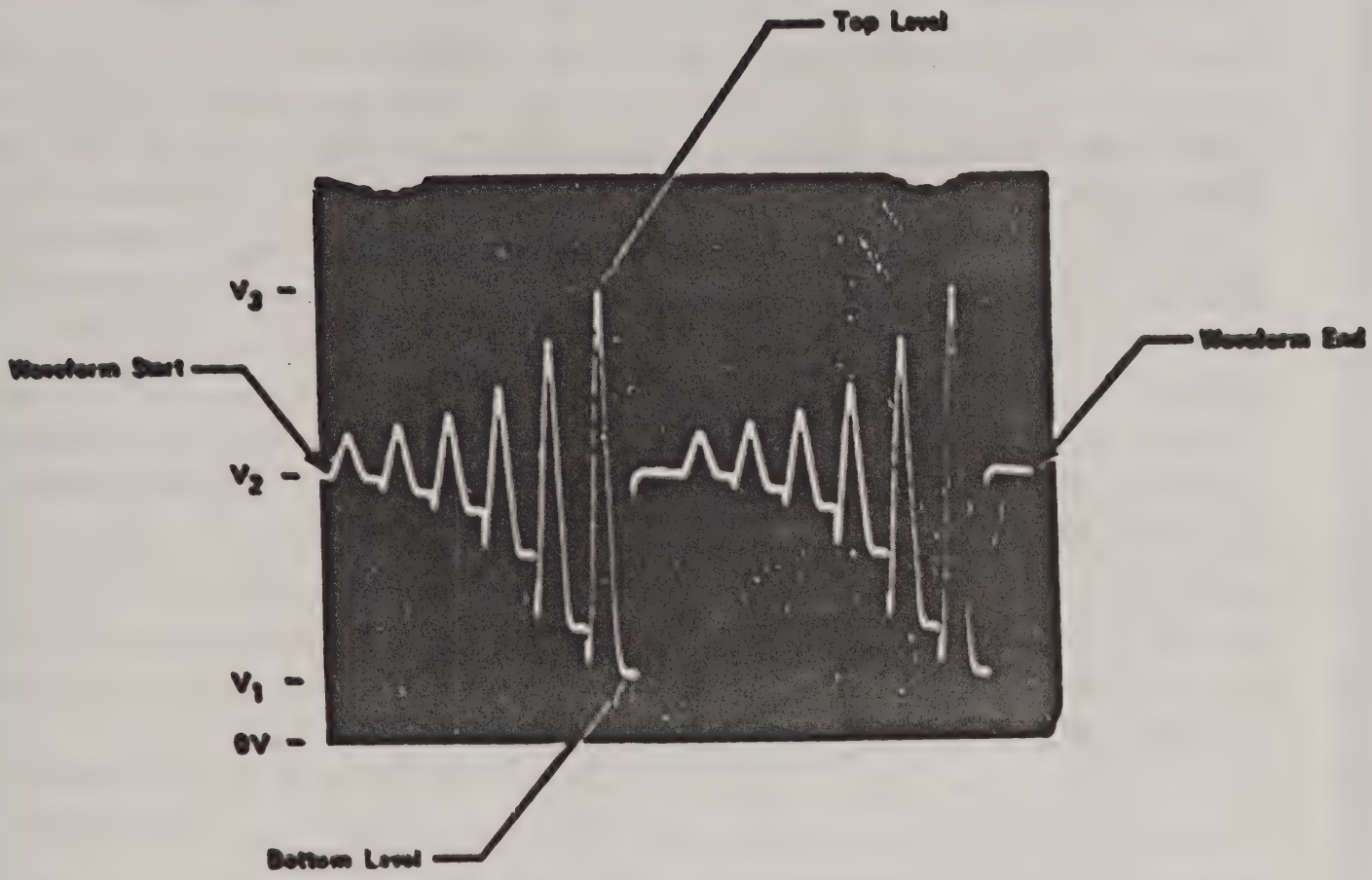

Figure 14. Input Loop Waveform

CALIBRATION CHECKLIST

TEST INST (5):

Hewlett Packard 5340A Opt 001, 002 Counter

PROC. NO. NA 17-20AF-77L MFR MODEL SER. NO.

PROCEDURE STEP NO. (1)	FUNCTION TESTED (2)		NOMINAL (3)	MEASURED VALUES FIRST RUN (4)	MEASURED VALUES SECOND RUN (5)	OUT OF TOL (6)	CALIBRATION TOLERANCES (7)
4.1	Self Check						
4.1.2	Amplitude	115 V	--				Reference amplitude
4.1.3	Frequency	115 V	10 MHz				9.999999 to 10.000001
4.1.5	Amplitude	105 V	--	ck ( )			Within 0.1 V of ref
	Frequency	105 V	10 MHz				9.999999 to 10.000001
4.1.7	Amplitude	125 V	--	ck ( )			Within 0.1 V of ref
	Frequency	125 V	10 MHz				9.999999 to 10.000001
4.1.9	Output amplitude		2.4 V p-p				2.4 V p-p or greater
4.1.10	Resolution (Hz)	10	10.00000				9.99999 to 10.00001
		100	10.0000				9.9999 to 10.0001
		1 k	10.000				9.999 to 10.001
		10 k	10.00				9.99 to 10.01
		100 k	10.0				9.9 to 10.1
		1 M	.010				.009 to .011
4.2	Sensitivity 10 Hz to 250 MHz Range						
4.2.3	Sensitivity	10 Hz	--	ck ( )			Stable count
		100 Hz	--	ck ( )			Stable count
		1 kHz	--	ck ( )			Stable count
		10 kHz	--	ck ( )			Stable count
		100 kHz	--	ck ( )			Stable count
4.2.5	Sensitivity	1 MHz	--	ck ( )			Stable count
		10 MHz	--	ck ( )			Stable count
		100 MHz	--	ck ( )			Stable count
		200 MHz	--	ck ( )			Stable count
		250 MHz	--	ck ( )			Stable count
4.3	Sensitivity 10 Hz to 1	GHz Range					
4.3.3	Sensitivity	10 Hz	--	ck ( )			Stable count
		100 Hz	--	ck ( )			Stable count
		1 kHz	--	ck ( )			Stable count
		1 MHz	--	ck ( )			Stable count

NAVAIR 17-20AF-77L
CALIBRATION CHECKLIST

TEST INST (5)

Hewlett Packard 5340A Opt 001, 002 Counter

PROC. NO. NA 17-20AF-77L MFR MODEL SER. NO.

PROCEDURE STEP NO. (1)	FUNCTION TESTED (2)	NOMINAL (3)	MEASURED VALUES FIRST RUN (4)	MEASURED VALUES SECOND RUN (5)	OUT OF TOL (6)	CALIBRATION TOLERANCES (7)
4.3.6	Sensitivity 1 MHz	--	ck ( )			Stable count
	10 MHz	--	ck ( )			Stable count
	100 MHz	--	ck ( )			Stable count
	200 MHz	--	ck ( )			Stable count
	250 MHz	--	ck ( )			Stable count
4.3.8	Sensitivity 500 MHz	--	ck ( )			Stable count
	1 GHz	--	ck ( )			Stable count
	3 GHz	--	ck ( )			Stalbe count
	5 GHz	--	ck ( )			Stable count
	7 GHz	--	ck ( )			Stable count
	9 GHz	--	ck ( )			Stable count
	10 GHz	--	ck ( )			Stable count
	12 GHz	--	ck ( )			Stable count
	14 GHz	--	ck ( )			Stable count
	16 GHz	--	ck ( )			Stable count
	18 GHz	--	ck ( )			Stable count
4.3.10	Sensitivity 500 MHz	--	ck ( )			Stable count
	1 GHz	--	ck ( )			Stable count
	3 GHz	--	ck ( )			Stable count
	5 GHz	--	ck ( )			Stable count
	7 GHz	--	ck ( )			Stable count
	9 GHz	--	ck ( )			Stable count
	10 GHz	--	ck ( )			Stable count
	12 GHz	--	ck ( )			Stable count
	14 GHz	--	ck ( )			Stable count
	16 GHz	--	ck ( )			Stable count
	18 GHz	--	ck ( )			Stable count
4.4	Oscillator					
4.4.3	Accuracy	--	ck ( )			$\leq 5 \times 10^{-9}$
4.4.6	Frequency change (105V)	--	ck ( )			$<0.1 \times 10^{-9}$
4.4.8	Frequency change (125V)	--	ck ( )			$\leq 0.1 \times 10^{-9}$
4.4.14	Stability	--	ck ( )			$\leq 2.1 \times 10^{11}$ per hour